



CARBON DISULPHIDE FUMIGATION OF BULK POTTING SOIL  
FOR THE WHITE-FRINGED BEETLE

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Carbon disulphide is commonly used for fumigating bulk soil, prior to its use for growing potted plants, to destroy infestations of the ecaphic stages of insects and other arthropods. All stages of the white-fringed beetle (Pantomorus leucoloma (Boh.)) are more or less inhabitants of the soil, and, under the provisions of Federal Quarantine No. 72, potted plants, to be eligible for movement from greenhouses in the quarantined area to outside points, must, among other requirements, be grown in soil free of this insect. The purpose of the experimental work reported in this paper was to determine the dosage of carbon disulphide and the length of exposure required to produce complete mortality of the white-fringed beetle in bulk quantities of potting soil. Experiments were also conducted with the congeneric species peregrinus Buch., the smaller white-fringed beetle. Although these species are closely related and it is probable that treatments applicable to one are applicable to both, studies with each were made, and the data are presented separately. The experimental work was carried out in Louisiana, Mississippi, and Alabama.

A method of disinfecting bulk potting soil of the white-fringed beetle by fumigation with methyl bromide has been previously described. 1/

Method and Procedure

A U. S. P. grade of carbon disulphide having a specific gravity of 1.25 at 68° F. was used. The general properties of this chemical are well known and, being somewhat constant, need not be given here. Its uses have been fully reviewed by Fleming and Baker. 2/ The vapors are highly

1/ Livingstone, E. M. Fumigation of bulk soil with methyl bromide for the white-fringed beetle in New Orleans. U. S. Dept. Agr., Bur. Ent. and Plant Quar., E-512, 4 pp. (mimeographed), September 1940.

2/ Fleming, W. E., and Baker, F. E. The use of carbon disulphide against the Japanese beetle. U. S. Dept. Agr., Tech. Bul. 478, 91 pp., July 1935.

inflammable and explosive and extremely injurious to plant life.

For fumatoria, metal drums holding 0.15 and 0.28 cubic yard of soil were used. The depth of soil in these ranged from 18 to 34 inches. The liquid fumigant was applied from a graduated glass cylinder to the surface of the soil, the dosage being divided among small holes about 3 inches deep, which, after receiving the fumigant, were covered with a handful of soil. The fumatoria were covered with friction-fitting metal covers during a constant exposure of 48 hours.

Insect material in the soil bulk was confined in small screen-wire cages distributed randomly at specific locations or was scattered unconfined throughout it. Adults were usually callow, but some older, more hardened, long-emerged individuals were included. Pupae were of all ages. Larvae in all stages of development except newly hatched ones were included; approximately 95 percent were full-grown, nonfeeding individuals. Adults, pupae, and larvae were collected in the field; eggs were laid in the laboratory by field-collected adults, were of varying ages when used, and were moistened, a prerequisite to hatching, after fumigation. Check or control lots of untreated eggs yielded satisfactory hatches.

Dosages of the fumigant ranged from one-half pound to 2 pounds per cubic yard of bulk soil and varied with the type of soil treated. At the end of the 48-hour exposure the insect material was removed from the soil and set aside on moist white sand for observations on mortality.

The mixtures of bulk soil fumigated were representative of types used by greenhouse men in growing potted plants commercially. None was wet when fumigated but all were friable and slightly moist. The manure in the mixtures was well rotted and had been sifted to remove lumps.

The experiments were conducted under natural temperature conditions.

#### Results of Experiments with the White-fringed Beetle, Pantomorus leucoloma (Boh.)

In the studies on the white-fringed beetle, larval and egg stages were employed and the tests carried out at New Orleans, La., and Tunnel Springs, Ala.

Three kinds of soil were fumigated in New Orleans. The soil principally employed was a mixture of approximately equal parts of brown river silt, swamp leafmold, well-rotted manure, and sand or field soil. This mixture, called "potting soil" in this paper, was friable, rich in humus, and highly absorptive. Other kinds of soil fumigated were alluvial silt, such as is deposited in the batture of the lower Mississippi River, and swamp leafmold obtained from the cutover, drained swamplands of New Orleans and vicinity. The data obtained on the larval stage with various dosages and types of soil in New Orleans are given in table 1.

Table 1.--Fumigation of three types of bulk soil with carbon disulphide for the larva of the white-fringed beetle, Pantororus leucolus (Boh.), with various dosages for 48 hours at New Orleans, La.

Series No.	Type of soil	Dosage in : lbs. per : cu. yd. : of soil :	Size of : soil : bulk in : cu. yds.	Temper- : ature : range : in °F. :	Larvae	
					Number used	Percent killed
1	Potting soil	2	0.13	42-66	96	100.0
2	Do.	2	0.13	42-66	162	100.0
3	Do.	2	0.13	42-66	111	100.0
4	Do.	2	0.13	42-66	152	100.0
5	Do.	2	0.13	42-66	93	100.0
6	Do.	2	0.13	42-66	117	100.0
7	Alluvial silt	1/2	0.28	76-85	210	100.0
8	Do.	1	0.28	76-85	209	100.0
9	Swamp leafmold	1/2	0.28	76-85	203	84.7
10	Do.	1	0.28	76-85	201	99.5
11	Do.	2	0.28	76-85	208	100.0

These data show that in "potting soil" a dosage of 2 pounds of carbon disulphide per cubic yard for an exposure of 48 hours gave a complete mortality of test larvae at temperatures ranging from 42° to 66° F. In swamp leafmold half-pound and 1-pound dosages for 48 hours failed to kill all the larvae, but a 2-pound dosage for the same period gave complete mortality at temperatures ranging from 76° to 85°. With alluvial silt, which contained only a small proportion of organic matter, 1/2 pound and 1 pound for 48 hours produced complete mortality at temperatures ranging from 76° to 85°.

At Tunnel Springs, Ala., potting soil made of red sandy loam top soil and well-rotted manure in varying proportions was fumigated with dosages of 1, 1½, and 2 pounds. The data obtained with the larval and egg stages are given in table 2.

The data in table 2 show that dosages of 1½ and 2 pounds of carbon disulphide per cubic yard of soil produced complete mortality of test larvae in mixtures composed of red sandy loam top soil and well-rotted manure in the following proportions: 3:1, 1:1, and 1:3. Temperatures ranged from a minimum of 39° to a maximum of 61° F. A dosage of 1 pound per cubic yard of soil failed to give a complete kill at somewhat similar temperatures. It should be pointed out that while complete mortality was obtained with the 1½-pound dosage, observations on the condition of the larvae following fumigation indicated that this dosage was only a little above the concentration which would produce a 100-percent kill. The 2-pound dosage, as evidenced by observations on the fumigated larvae, appeared to be well above this point.

Eggs were fumigated in a soil mixture composed of 1 part of red sandy loam and 3 parts of well-rotted manure with dosages of 1 pound and 2 pounds. In the tests with larvae this mixture represented the highest in organic matter and therefore probably had the highest absorptive capacity. The data for the egg stage given in table 2 show that the 1-pound dosage failed to give a complete kill in a temperature range of 38° to 49° F. The eggs that survived were on the surface of the soil bulk. The 2-pound dosage gave a complete kill at temperatures ranging from 45° to 59°.

Results of Experiments with the Smaller White-Fringed Beetle,  
Pantomorus peregrinus Buch.

In experiments with the smaller white-fringed beetle the adult, pupal, larval, and egg stages were used, and the work was done at Gulfport and Saucier, Miss. Varying dosages of fumigant were used. Several mixtures of soil composed of varying proportions of gray sandy loam top soil and well-rotted manure were fumigated. The experiments were performed at higher temperatures than were the greater part of those with Pantomorus leucoloma.

The data for all stages are given in table 3 and show that all were killed by a 2-pound dosage at temperatures that ranged from a minimum of 72° to a maximum of 88° F. The soils fumigated were gray sandy loam and mixtures of it and well-rotted manure in proportions of 1:3, 1:1, and 3:1. Not all stages were fumigated in each mixture.

Table 2.--Fumigation of several types of bulk soil with carbon disulphide for the larva and egg of the white-fringed beetle, Pantororus leucoloma (Boh.), with dosages of 1, 1.5, and 2 pounds per cubic yard of soil for 48 hours at Tunnel Springs, Ala.

	:	:	Dosage in	:	Size of	:	Temper-	:	
	:	:	lbs. per	:	soil	:	ature	:	<u>Insects</u>
Series:	:	:	cu. yd.	:	bulk in	:	range	:	Number:Percent
No. :	Type of soil:	:	of soil	:	cu. yds.: in	:	°F.	:	used :killed

#### Fumigation of Larval Stage

48M	Top soil 3 parts; manure 1 part.	1.0	0.28	35-50	280	99.6
51M	Do.	1.5	0.28	39-51	275	100.0
43M	Do.	1.5	0.28	41-52	302	100.0
54M	Do.	1.5	0.28	45-61	280	100.0
34M	Do.	2.0	0.28	45-59	319	100.0
47M	Top soil 1 part; manure 1 part.	1.0	0.28	36-48	283	100.0
50M	Do.	1.5	0.28	39-51	276	100.0
42M	Do.	1.5	0.28	42-52	306	100.0
53M	Do.	1.5	0.28	45-61	278	100.0
35M	Do.	2.0	0.28	45-59	310	100.0
46M	Top soil 1 part; manure 3 parts.	1.0	0.28	38-49	281	85.4
49M	Do.	1.5	0.28	41-51	278	100.0
41M	Do.	1.5	0.28	43-54	301	100.0
52M	Do.	1.5	0.28	45-61	278	100.0
38M	Do.	2.0	0.28	45-53	360	100.0
36M	Do.	2.0	0.15	45-59	284	100.0
37M	Do.	2.0	0.15	47-59	312	100.0

#### Fumigation of Egg Stage

46M	Top soil 1 part; manure 3 parts.	1.0	0.28	38-49	412	96.6
38M	Do.	2.0	0.28	45-53	146	100.0
37M	Do.	2.0	0.15	47-59	321	100.0

<sup>1</sup>The top soil used was red sandy loam, and the manure was well rotted.

Table 3.--Fumigation of bulk soil with carbon disulphide for the adult, pupa, larva, and egg of the smaller white-fringed beetle, Pantomorus peregrinus Buch., with a constant dosage of 2 pounds per cubic yard for 48 hours at Gulfport and Saucier, Miss.

Series:	Type of soil:	No. :	Dosage in lbs. per cu. yd.	Size of soil bulk in cu. yds.	Temper- ature range in °F.	Insects	
						Number:	Percent
						used	killed

#### Fumigation of Adult Stage

81G	Top soil 1 part; manure 3 parts.	2	0.28	76-88	7	100.0
79G	Top soil 3 parts; manure 1 part.	2	0.28	76-88	67	100.0

#### Fumigation of Pupal Stage

81G	Top soil 1 part; manure 3 parts.	2	0.28	76-88	10	100.0
80G	Top soil 1 part; manure 1 part.	2	0.28	76-88	15	100.0
79G	Top soil 3 parts; manure 1 part.	2	0.28	76-88	73	100.0
75G	Top soil	2	0.28	72-88	38	100.0

#### Fumigation of Larval Stage

81G	Top soil 1 part; manure 3 parts.	2	0.28	76-88	199	100.0
80G	Top soil 1 part; manure 1 part.	2	0.28	76-88	298	100.0
79G	Top soil 3 parts; manure 1 part.	2	0.28	76-88	221	100.0
75G	Top soil	2	0.28	72-88	179	100.0

#### Fumigation of Egg Stage

79G	Top soil 3 parts; manure 1 part.	2	0.28	76-88	330	100.0
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\*The top soil used was gray sandy loam, and the manure was well rotted.

### Summary

Experimental work with carbon disulphide as a fumigant for various types of potting soil in bulk quantities showed that infestations of Pantomorus leucolora (Boh.), the white-fringed beetle, and P. peregrinus Buch., the smaller white-fringed beetle, were destroyed by dosages of  $1\frac{1}{2}$  pounds per cubic yard and an exposure of 48 hours at temperatures that ranged from a minimum of 39° to a maximum of 88° F. Because of the known tendency of insects to revive at long intervals following fumigation with carbon disulphide, many tests were carried out with the slightly higher dosage of 2 pounds. At this dosage there appeared to be no likelihood of revival taking place.



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